Space Weather Technical Forecast

Issued on Thursday, 12 May 2022 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: R1-R2 radio blackouts likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with an M2.6 flare at 11/1859 UTC which consisted of a long period flare from EX3004 from around the western limb combined with a short flare from AR3007. Two CMEs have been detected from this event, after analysis neither are thought to be Earth directed. There are currently four numbered sunspots on the visible disk, with returning regions now emerging on the eastern limb. AR3006 is continuing to weaken. AR3007 remains the largest and most complex sunspot. It resides in the southeast quadrant and is continuing to develop. There are two simple and small Beta spots in the northern hemisphere, mirroring the longitudes of the larger spots to the south.
Solar Wind / Geomagnetic Activity: The solar wind as measured at L1 has been slow-ambient around 300 km/s. Density has been mostly at above average levels with a maximum of 32ppcc at 12/1130 UTC. Total interplanetary magnetic field strength was weak or moderate with a maximum of 11nT. The Bz fluctuated between positive and negative values within the range -10/+9 nT. The Phi angle has remained mostly negative (towards the Sun). Geomagnetic activity has been Quiet throughout (Kp 1-2).
Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) rose to moderate in response to the M2.6 flare from 11/1859 UTC, peaking at 5.45e0 ppcc at 12/0405 UTC. High energy electron flux (greater than 2 MeV) has remained at background levels. The Electron fluence is well below the Active (1e8 integrated pfu) threshold with a mostly flat trend and a value of 1.3e6 integrated pfu observed at 12/0000 UTC.

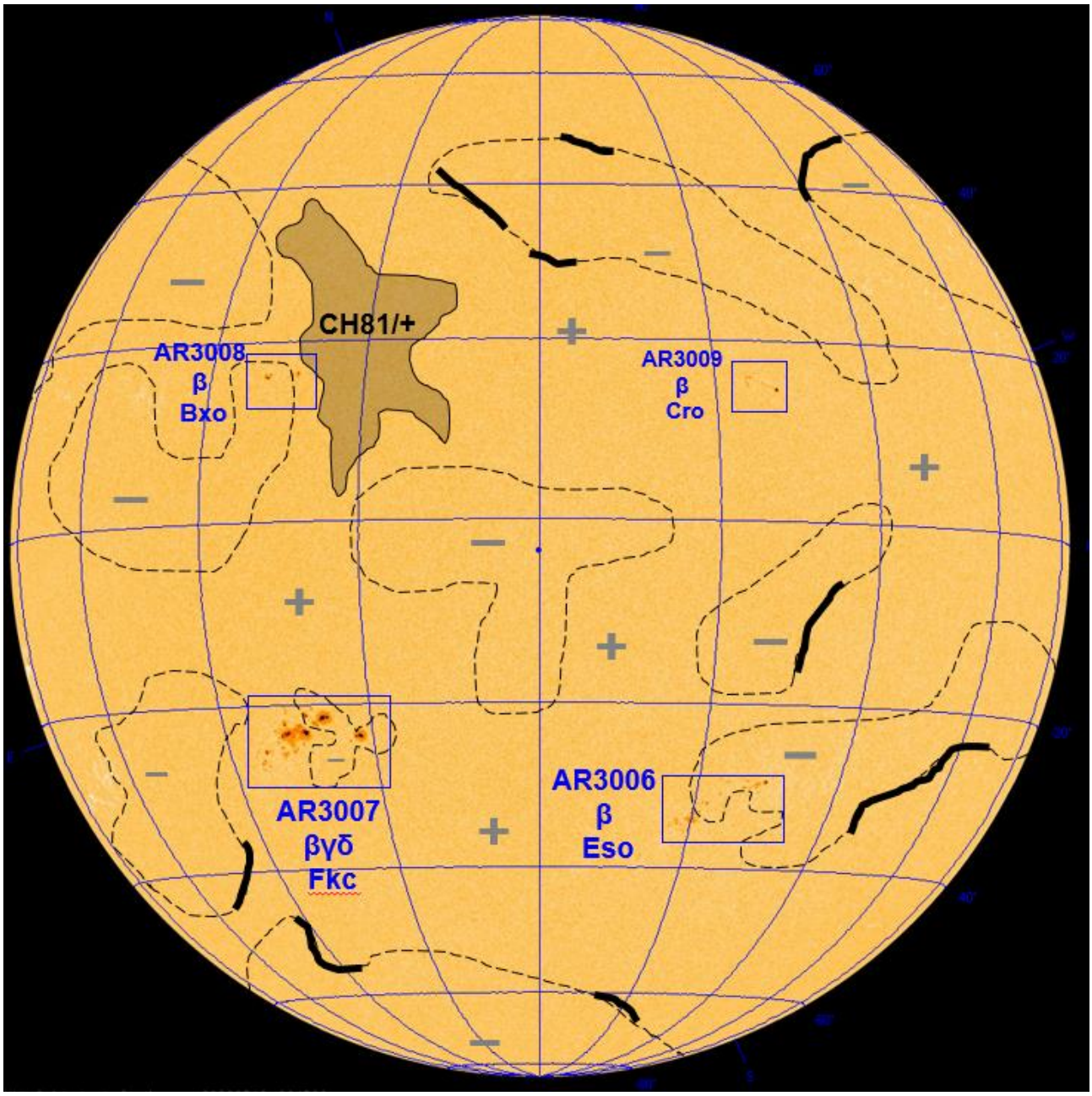
Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate (R1/R2) with a slight chance of Strong (R3) X class flares due to the presence of the complex sunspot regions in the south, AR3007.
Solar Wind / Geomagnetic Activity: No significant enhancements are expected in solar winds in the next 4 days, though there remains an uncertain chance of activity during day 1 or 2 (12 or 13 May) should any extended periods of negative Bz occur. Therefore, geomagnetic activity is currently expected to be mainly Quiet (Kp 0-2) with Unsettled (Kp3) periods and a slight chance of Active (Kp4) intervals on days 1 and 2 (12th and 13th).
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to start at moderate levels but fall back to background levels. Though any significant flares from AR3007 may enhance proton flux, the risk slowly increases as the region approaches the western hemisphere. The high energy electron flux (greater than 2 MeV) is forecast to remain at normal background levels. The 24-hour electron fluence is expected to remain below the Active threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 12/0700 UTC.



.

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

An X1.5 flare on 10 May from south-centre disc appears to have produced an asymmetric CME, combining with a long-period flare from the eastern limb. Coronagraph analysis remains inconclusive and although there is a chance of seeing a transient feature at L1 later on 12th or early 13th May, this remains unlikely, with no significant portion of this CME complex heading for Earth.

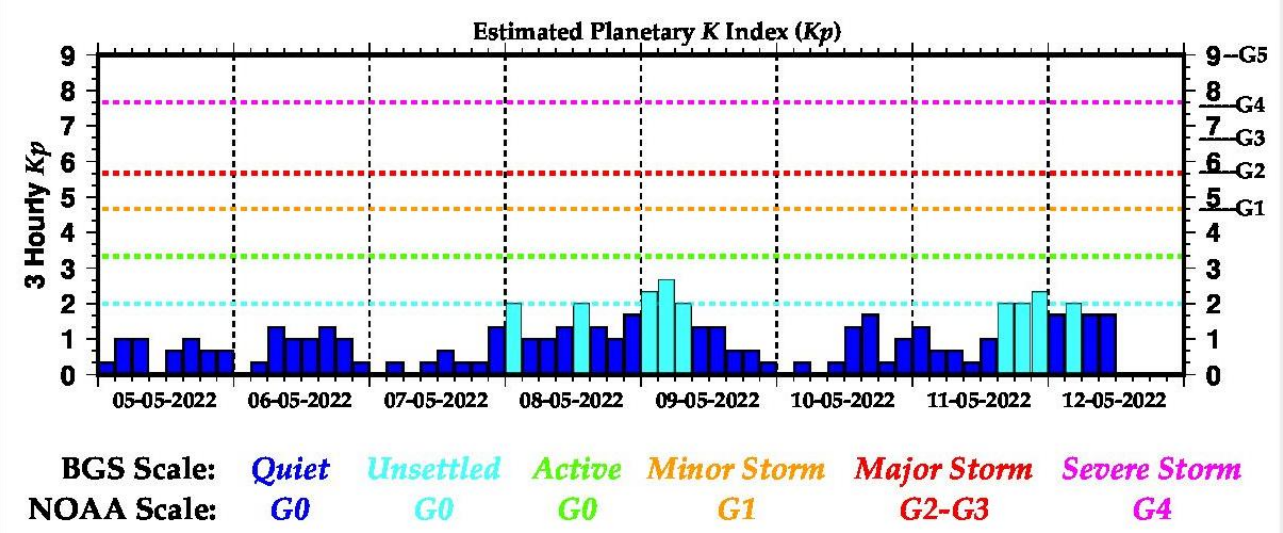
Three CMEs that left the Sun on 11th May from EX3004, AR3007 and a region over the eastern limb. Analysis suggests none of these have an Earth-directed component.

CH81/+ looks to possibly arrive after this forecast period (16th May), bringing solar wind speeds of around 500 km/s. Enlil shows an earlier arrival of this feature, perhaps in part due to CH81 being displaced further east and smaller than on the previous rotation.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	2	2
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Kp has been Quiet for several days.



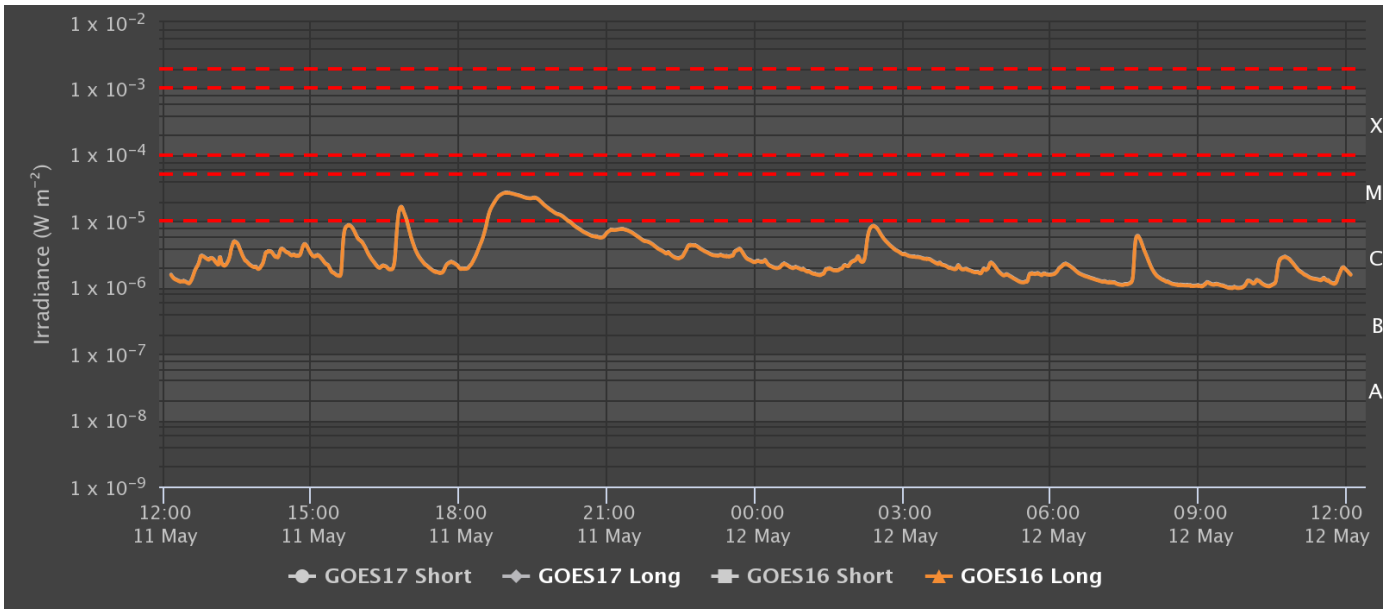
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
Solar activity was Moderate in the past 24 hours. The most recent significant flare of the period was an M2.6 peaking at 11/1859 UTC, originating from EX3004, which left the visible disk around the western limb approx. 48 hours ago. A flare was also recorded at AR3007 during the same period. There remains a likelihood of further M-class flares, these most probably originating from AR3007, which appears to be increasing in size and magnetic complexity. There also remains a slight chance of an isolated X-class flare from this region. There is evidence of a bright region and flare activity close to the east limb at present, with a sun spot region emerging in the southeast, risks will be evaluated accordingly when analysis can take place as this region rotates into view.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	50	50
Very Active	R3 to R5 X Class	No	15	15	10	10

Figure 3:GOES16 X-Ray flares shows the long duration M flare peaking around 11/12900 UTC.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

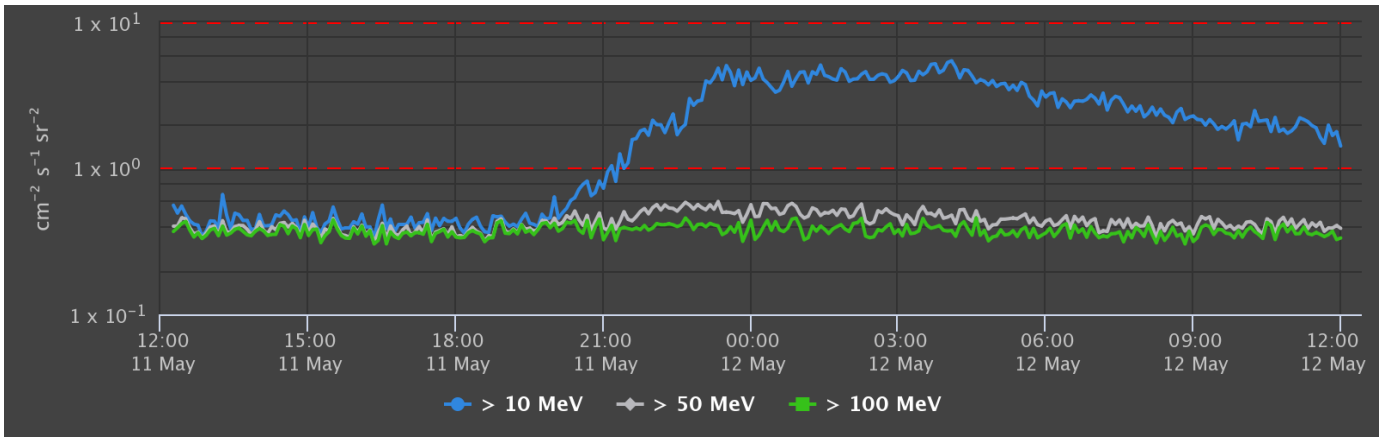
© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is expected to start at moderate levels but fall back to background levels. Though any significant flares from AR3007 may enhance proton flux, the risk slowly increases as the region approaches the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	2	3
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton Flux increased following the M flare, but remains below the S1 threshold.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

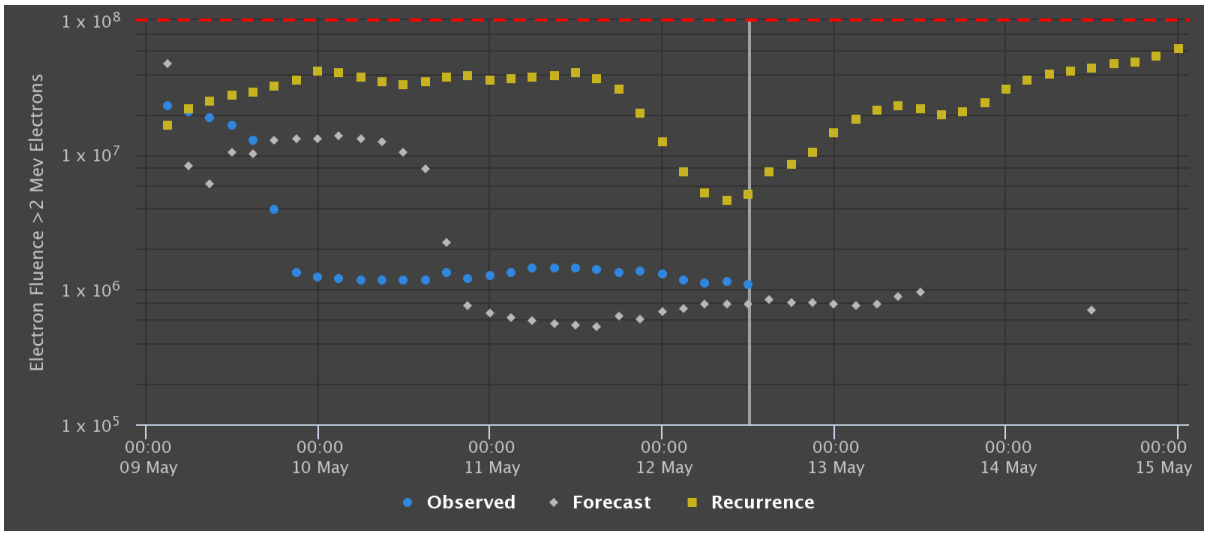
© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is expected to be at mainly low background levels through the forecast period with no significant solar winds currently anticipated. Therefore the Electron fluence levels are also expected to remain well below the Active threshold and are not expected to increase significantly at this stage.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM Model is forecasting integrated electron fluence levels below 1e8 Active.



NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.